Bull. Southern California Acad. Sci.
83(2), 1984, pp. 76–83

Paraliparis nassarum n. sp. (Pisces, Liparididae) from off Southern California with Description of Its Otoliths and Others from North-east Pacific Liparidids

David L. Stein and John E. Fitch

Abstract.—*Paraliparis nassarum* n. sp. (Pisces, Liparididae) from off southern California with description of its otoliths and others from north-east Pacific liparidids by David L. Stein and John E. Fitch. *Bull. Southern California Acad. Sci.*, 83(2):76–83, 1984. *Paraliparis nassarum*, a previously unknown species of liparidid fish, is described from specimens collected in sablefish traps on the continental slope off southern California. The new species is primarily distinguished from *P. rosaceus*, its most similar relative, by having sparser premaxillary teeth, mandibular teeth slanted anteriorly, fewer vertebrae, more pectoral fin rays, and more caudal fin rays.

Sagittal otoliths of *P. nassarum*, *P. rosaceus*, *Careproctus furcellus*, *C. attenuatus*, *C. melanurus*, *C. ovigerum*, *Acantholiparis opercularis*, *Lipariscus nanus*, *Nectoliparis pelagicus*, *Liparis liparis*, and *L. pulchellus* are described. The ostium of the otoliths of *A. opercularis*, *L. nanus*, *P. nassarum*, and *P. rosaceus* is closed over to form a tube, an apparently unique character among fishes. The medial face of the otolith of *C. ovigerum* is concave, unlike the flat medial faces of the otoliths of the other 10 species.

These significant differences in otolith morphology suggest that our present understanding of liparidid relationships is inadequate and that liparidid genera may need revision.

During the past few years, commercial vessels fishing with traps for sablefish (*Anoplopoma fimbria* [Pallas]) off southern California have captured many individuals of a previously undescribed species of *Paraliparis*, of which specimens were deposited at the Los Angeles County Museum of Natural History. This paper describes the new *Paraliparis*, which appears to be relatively common, and describes its otoliths and the otoliths of 10 other species of liparidids including *Paraliparis rosaceus* Gilbert, *Careproctus furcellus* Gilbert and Burke, *C. attenuatus* Gilbert and Burke, *C. melanurus* Gilbert, *C. ovigerum* (Gilbert), *Acantholiparis opercularis* Gilbert and Burke, *Lipariscus nanus* Gilbert, *Nectoliparis pelagicus* Gilbert and Burke, *Liparis liparis* (Linnaeus), and *Liparis pulchellus* Ayres.

Methods and Materials

All specimens were collected in sablefish traps by commercial fishermen. Materials examined are on deposit at the Natural History Museum of Los Angeles County (LACM), U.S. National Museum of Natural History (USNM), and California Academy of Sciences (CAS).

Methods of making measurements and counts follow Stein (1978). Counts and ratios given are the mode and mean respectively, the range in parentheses, and

the number of observations for that character in brackets. Internal organs of many specimens were in poor condition, often making sex determination impossible. Premaxillaries of three specimens having different numbers of teeth were cleared and stained with alizarin or with alcian and alizarin (Dingerkus and Uhler 1977) for closer examination. Otoliths from preserved (*P. rosaceus, L. nanus, A. opercularis*) and fresh (all other species) specimens were photographed with a scanning electron microscope (SEM).

Paraliparis nassarum new species
Fig. 1, 2b

Holotype.—LACM 38272-3, ♀, 229 mm SL, 18.5 km ENE of Pyramid Hd., San Clemente I., Calif., <4:X:1978, 951–1097 m.

Paratypes (38 specimens).—LACM 38342-4, ♀, 196+ mm SL, 32°18′N, 118°06′W, off Baja California, Mexico, 16:III:1979, 1024–1097 m; LACM 37278-1, ?, 250+, ?, 283 mm SL, off Santa Barbara I., Calif., <24:I:1978, 914 m; LACM 38272-2, ♂, 196 mm SL, 18.5 km ENE of Pyramid Hd., San Clemente I., Calif., <4:X:1978, 951–1097 m; LACM 37607-1, ♂?, 204, ?, 232, ?, 241, ♀, 242, ?, 256, ?, 257 mm SL, 5.6–18.5 km E by N and E by S of San Clemente I., Calif., <19:VII;1978, 1006 m; LACM 37666-1, ♀, 207, ?, 236, ♀, 260 mm SL, 5.6–9.2 km NE by N of Pyramid Hd., San Clemente I., Calif., 15:VIII:1978, 1006 m; LACM 37601-1, ♀?, 214, ?, 215, ♀?, 240, ♀, 252 mm SL, 5.6–14.8 km SE of San Clemente I., Calif., <3:VII:1978, 1006 m; LACM 37596-1, ♂, 226 mm SL, 32°29′N, 118°57′W, off Calif., <26:VI:1978, 900 m; LACM 37599-1, ?, 230 mm SL, 5.6–14.8 km SE of San Clemente I., Calif., <10:VII:1978, 1006 m; LACM 37600-1, ♀?, 234, ?, 243, ?, 248+ mm SL, 5.6–14.8 km SE of San Clemente I., Calif., <10:VII:1978, 1006–1189 m; CAS 51781, ♂, 234, ♂, 258 mm SL, nr. 33°05′N, 118°20′W, off Calif., 1042 m, 12:V:1978; LACM 37462-1, ♀, 235 mm SL, 20.4 km 0° from E end of Santa Catalina I., Calif., 22:V:1978, 1159 m; LACM 376641, ?, 236 mm SL, 21.3 km, 315° to E end of Santa Catalina I., Calif., 2:VIII:1978, 1070 m; LACM 37460-2, ♂, 239, 37460-1, ♂, 277 mm SL, 9.2 km, 350° off E end of Santa Catalina I., Calif., 5:VI:1978, 1152 m; LACM 37597-1, ♀, 240 mm SL, 9.2 km, 330° to E end of Santa Catalina I., Calif., 2:VII:1978, 1001 m; LACM 37459-1, ♀, 244 mm SL, 15.7 km, 345° off E end of Santa Catalina I., Calif., 28:V:1978, 1120 m; USNM 247250, ♂?, 253 mm SL, 11.6 km, 002° from E end of Santa Catalina I., Calif., 10:VI:1978, 1161 m; LACM 37336-1, ?, 269 mm SL, off San Clemente I., Calif., 16–23:I:1978, 1134 m; USNM 247249, ♀, 278 mm SL, 10.2 km, 340° to E end of Santa Catalina I., Calif., 1:VII:1978, 1143 m; LACM 37277-1, ?, 281, ♀, 285 mm SL, San Clemente Canyon, Calif., 16–23:I:1978, 1280 m; LACM 38507-2, ♂, 294 mm SL, 55.5 km SW of San Nicholas I., Calif., 6:VI:1979, 914 m; LACM 38667-1, ♂?, 313 mm SL, SW of San Nicholas I., Calif., <7:I:1980, 914 m; LACM 38357-1, ♀, 318 mm SL, 32°22.5′N, 118°38.0′W, off Baja California Mexico, <10:I:1979, 1097 m.

Diagnosis

A *Paraliparis* differing from all others in the following characters or combinations thereof: 51–55 anal fin rays, 21–24 pectoral fin rays, 8–9 caudal fin rays, and 64–67 vertebrae. Premaxillary teeth absent or 1–15 present anteriorly on each

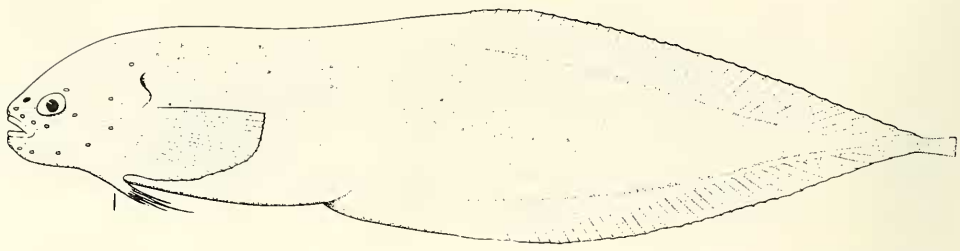

Fig. 1. Holotype of *Paraliparis nassarum,* new species, LACM 38272-3, 229 mm SL. Drawn by Donna Klentz.

premaxillary. A complete uniserial row of simple, triangular, anteriorly slanting canines present on each side of lower jaw.

Counts and Ratios.—Dorsal fin rays 60 (56–61) [29], anal fin rays 52 (51–55) [29], pectoral fin rays 22 (21–24) [51], caudal fin rays 8 (8–9) [33], pyloric caeca 7 (6–9) [17], vertebrae 66 (64–67) [31]. Cephalic sensory pores 2-6-7-1.

Head length 19.0 (17.2–20.8) [32]%SL; head depth at occipital 80.1 (69.9–90.4) [12]%HL, diameter of eye 14.4 (12.6–16.3) [23]%, length of upper pectoral fin lobe 70.9 (60.4–81.2) [31]%, length of lower pectoral fin lobe 60.7 (44.4–76.9) [29]%, mandible to anus 81.8 (67.1–100.2) [27]%, maximum body depth 105.5 (93.8–124.2) [13]%. Upper jaw 37.0 (32.9–41.8) [32]%.

Description

Snout blunt, dorsal profile of head rising rapidly to occipital region. Nostrils single, without a raised rim; external opening anterior to orbit a distance distinctly less than diameter of eyeball, on a horizontal through pupil of eye. Eye small, covered by skin; pupil round. Mouth subterminal, jaws horizontal, broad. Lower jaw slightly included by upper. Maxillary extending posteriorly to below orbit. Teeth of both jaws small, simple. Premaxillary teeth smaller than those of dentary, often obscure, occasionally completely absent. When present, premaxillary teeth form a single series posteriorly, often irregularly biserial or triserial near symphysis. Number of teeth present on each premaxillary varies from none to about 15, usually 4–10 present. Dentary teeth extending posteriorly behind cleft of mouth, closely spaced, forming a single series except often irregularly biserial or triserial near symphysis of mandible. Teeth simple, stout, curved canines, pointing distinctly anteriorly. Largest teeth posteriormost, gradually decreasing in size towards symphysis. Cephalic pores moderately large, not obvious. Gill opening small, completely above pectoral fin base. A small, weak opercular flap present, formed by reduced opercle.

Pectoral fins large, broad based, clearly divided into two lobes by a deep notch. Dorsalmost ray of upper lobe about on or below horizontal through posterior end of suborbital stay. Upper lobe of 15–19 rays, posterior margin broadly rounded. Distance between individual rays more or less gradually increasing from narrow to very wide in notch. Rays of notch entering margin of fin, not rudimentary. Lower fin lobe usually of 4 (occasionally 3) rays, narrowly spaced. Dorsalmost lower fin lobe ray often farther from lower rays than they are from each other. Lower pectoral fin lobe shorter than upper lobe.

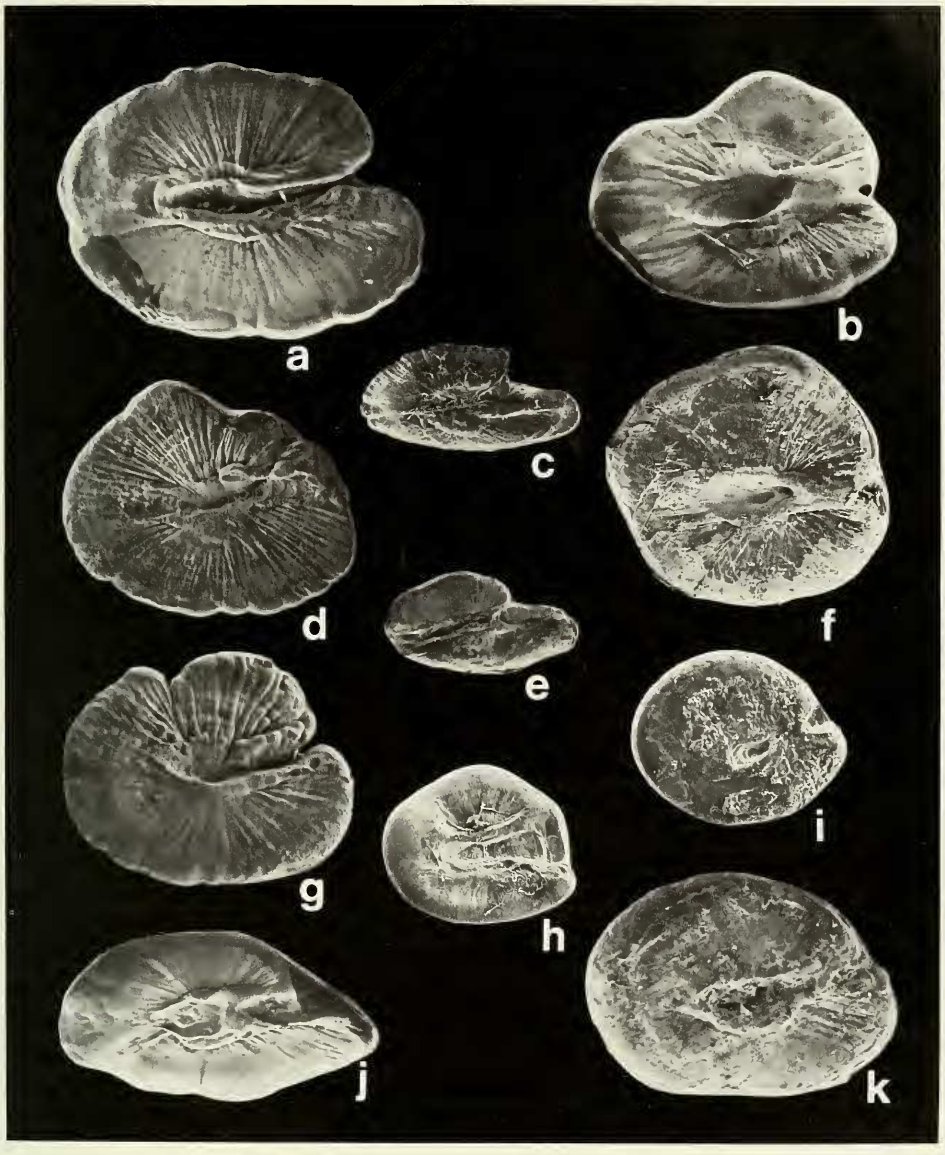

Fig. 2. Medial faces, left sagittae of 11 species of liparidids that inhabit waters of the eastern north Pacific and Bering Sea. Species name is followed by otolith length and height (in mm) and standard (SL) or total length of the fish it came from (if known): a. *Careproctus melanurus* 3.1 by 2.4 (203 mm SL); b. *Paraliparis nassarum* 2.5 by 2.0 (304 mm SL); c. *Liparis liparis* 1.9 by 0.9 (unk.); d. *Careproctus furcellus* 3.7 by 2.9 (unk.); e. *Liparis pulchellus* 2.8 by 1.5 (178 mm SL); f. *Paraliparis rosaceus* 1.9 (207 mm SL); g. *Careproctus attenuatus* 3.3 by 2.8 (unk.); h. *Nectoliparis pelagicus* 0.8 by 0.7 (94 mm TL); i. *Lipariscus nanus* 0.6 by 0.5 (36 mm TL); j. *Careproctus ovigerum* 3.0 by 1.6 (270 mm SL); k. *Acantholiparis opercularis* 1.2 by 0.9 (69.1 mm SL). SEM photos by Brian White.

Dorsal and anal fins well developed. Anterior rays of dorsal fin poorly developed, buried in gelatinous tissue, indistinct. Dorsal fin origin above or behind opercular flap. Anterior rays of anal fin distinct, well developed.

Body heavy, laterally compressed, deepest behind head. Tail tapers gradually to caudal fin, not particularly attenuate. Dorsal and anal fin rays overlap caudal fin rays by half to three-fourths caudal fin length. Skin usually thin, lax, easily damaged; occasionally thicker and tougher. Rudimentary pores present on head and extending in an irregular lateral line-like row posteriorly to behind anal fin origin.

Stomach large, thick-walled, pale, located dorsally in body cavity. Pyloric caeca covering anteroventral surface of stomach; pale, fingerlike, matted together, difficult to separate.

Color in life unknown. In alcohol, skin of most specimens pinkish-brown, except darker brown or blackish head and fins. Inside of mouth and brachial chamber dusky brown, peritoneum black. Peritoneum sometimes visible through thoracic wall and skin.

Distribution

Paraliparis nassarum is known from sablefish traps on the continental slope off southern California (mostly near the Channel Islands) and Baja California, Mexico. Depths of capture are only approximate, but all specimens were collected between about 900–1280 m. Because of the nature of the collections (incidental captures in a commercial fishery) distribution is not well known. Future captures will undoubtedly extend the known range.

Etymology

The specific epithet, *nassarum,* is the genitive plural of the Latin noun, *nassa,* "fish trap," and is appropriate because all known specimens were collected by fish traps.

Discussion

Paraliparis nassarum is most similar to *P. rosaceus,* which also occurs off southern California but at greater depths. The most obvious differences are the mandibular teeth (in *P. rosaceus* they are not angled forward), the paucity of premaxillary teeth (in *P. rosaceus* there is always at least a complete single tooth series extending half way or farther towards the posterior end of the oral cleft and there is often more than a single series medially), fewer vertebrae (67–71 in *P. rosaceus*) more pectoral fin rays (18–22 in *P. rosaceus*) and more caudal fin rays (6[6–8] in *P. rosaceus*).

The description of *Paraliparis nassarum* raises to five the number of species of the *P. rosaceus* "group" which have uniserial premaxillary teeth as adults. These species are *P. attenuatus* Garman, *P. copei* Goode and Bean, *P. nassarum, P. rosaceus,* and *P. wilsoni* Richards. They have the same general appearance, similar numbers of vertebrae and fin rays, tooth patterns and tooth morphology, pectoral fin morphology, and gill opening position. Despite the variable presence of premaxillary teeth and absence of mandibular teeth, *P. paucidens* Stein can presently be included in the group based on the other characters. The true relationships of these species are unclear at present and require analysis based upon other characters, including otoliths.

Otoliths

Liparidid otoliths (sagittae) have been found in digestive tracts of pinnipeds (Frost and Lowry 1980), small cetaceans, marine birds and occasionally predatory fish (J. E. Fitch, unpublished data). Although they have been reported from the Oligocene of Belgium (as "genus aff. *Liparis*" *minusculus* Nolf, 1977), the only North American fossil record appears to be an unreported otolith (*Liparis* cf. *fucensis*) from a Pliocene deposit near Santa Barbara, California (J. E. Fitch, unpublished data). If it were not for their small size (often much less than 5 mm diameter), we suspect that liparidid sagittae would be encountered and recognized much more frequently, both in digestive tracts and as fossils. Because of their potential importance in systematic and food habit studies and as fossils, we have included photos taken with an SEM of sagittae from 11 species (6 genera) of liparidids occurring in the eastern North Pacific and Bering Sea (Fig. 2).

The first known description of a snailfish otolith is that of *Liparis vulgaris* (=*L. liparis*) in a dissertation by Fryd (1901). Subsequently, Chaine (1956) described and figured a sagitta of *Liparis montagui* (Donavan), Nolf (1977) did the same for *L. liparis,* and Morrow (1979) illustrated sagittae of *Careproctus* sp., *C. furcellus, C. melanurus, Liparis dennyi* Jordan and Starks, *L. gibbus* Bean, *L. liparis, L. pulchellus,* and *Nectoliparis pelagicus.* Unfortunately, most of these authors used line drawings or stippled figures and failed to show salient features which are critical for identifying otoliths accurately.

Characters on the medial faces (grooved side) of otoliths are extremely important for determining family and genus. Overall otolith shape, ratio of height into length, marginal ornamentation, etc., are important primarily at the species level. Among the otoliths we have figured (Fig. 2), two features of the sulcus (groove on medial face) are prominent: its relative depth, and differences in the ostium (front portion of the sulcus). In *Acantholiparis, Lipariscus,* and *Paraliparis,* the ostium is closed over forming a tube; in *Careproctus, Liparis,* and *Nectoliparis* the sulcus is an open channel for its entire length. We know of no other fish family in which the ostium of the otolith is tubular. Unfortunately, we do not know how widespread occurrence of the tubular ostium is among liparidids. We have not seen sagittae of species of the other five described genera of eastern North Pacific liparidids, so we do not know how many of these, if any, have tubular ostia also.

All of our figured otoliths are medial faces of left sagittae. Those of *Paraliparis rosaceus* (Fig. 2f), *Lipariscus* (Fig. 2i), and *Acantholiparis opercularis* (Fig. 2k) are from specimens preserved in formalin for a short period. Such preservation caused a slight chalkiness, so some of the finer features (e.g., radiating striae) are not as distinct as those from otoliths from unpreserved specimens. Otolith shapes and proportions as seen in the illustrated sagittae are typical for adults of each species.

The lateral faces (not shown) of the 11 figured otoliths are all smoothly rounded, whereas the medial faces of all except *Careproctus ovigerum* (Fig. 2j) are flat. In *C. ovigerum* the medial face is concave (anterior to posterior), a condition extremely rare among teleost otoliths. In all except *Acantholiparis, Liparis,* and *Lipariscus,* both the cristae superior and inferior (ridges bordering the sulcus) are very strong and distinct. In *Acantholiparis* and *Lipariscus,* neither is distinct, in *Liparis pulchellus* (Fig. 2e) only the crista superior is strong, but in *L. liparis* (Fig. 2c) the opposite is true with only the crista inferior well developed.

In *Careproctus ovigerum, Liparis, Nectoliparis pelagicus* (Fig. 2h) and *Paraliparis,* the sulcus is straight or nearly so for its entire length. In the other species of *Careproctus,* as well as in *Lipariscus* and *Acantholiparis* the ostial portion of the sulcus is bowed upwards.

Each species of *Liparis* has an extremely long rostrum (anteroventral projection); in the other genera and species, rostra are short and bluntly rounded or indistinct. Radiating ridges or striae are present in all species (medial faces), but are most distinct in *Careproctus furcellus* (Fig. 2d), *C. attenuatus* (Fig. 2g) and *C. melanurus* (Fig. 2a) among the figured species.

The apparently unique tubular ostium of *P. nassarum, P. rosaceus, A. opercularis,* and *L. nanus* suggests a previously unsuspected close relationship between these genera. Whether all species presently considered members of *Paraliparis* and *Acantholiparis* also possess this character state is unknown (*Lipariscus* is a monotypic genus). Additional information about the occurrence of the tubular ostium would test the hypothesis of Andriashev, Neelov, and Prirodina (1977) that *Paraliparis* is a taxonomic construct.

As noted above, the otolith of *C. ovigerum* is distinctly different from the other otoliths examined. In this connection, it is interesting to note that *C. ovigerum* was originally described by Gilbert (1895) as *Bathyphasma ovigerum,* and was later synonymized with *Careproctus* by Burke (1930), who commented ". . . *Careproctus* . . . is probably a polyphyletic [genus] but with our present knowledge we certainly are not justified in dividing it." This study supports the hypothesis that the original assignment of *C. ovigerum* to a different genus may have been correct. A final decision awaits further studies.

Acknowledgments

We have received assistance from many people. We would particularly like to thank Robert Lavenberg, LACM, for loaning specimens and Brian White, LACM, for the scanning electron microscope photos. Dirk Nolf, Geologische Institut, Rijksuniversiteit Gent, Belgium; Ed Best, International Pacific Halibut Commission, Seattle; Richard Grinols, formerly of National Marine Fisheries Service, Seattle; James Morrow, formerly of the University of Alaska; Greg Cailliet, Moss Landing Marine Laboratories; and Dorothy Pillion, California State College at Long Beach supplied liparidid otoliths. We would especially like to thank the commercial fishermen who donated specimens of *P. nassarum* via James Phelan, California Department of Fish and Game. Without their assistance the new species would have remained unknown to science.

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Accepted for publication 14 June 1983.

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